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Leadership in Teams: Signaling or Reciprocating ?

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Abstract

How does leadership work in teams? In this paper, leadership is grounded on both the possession of a private information by the leader and by her ability to communicate credibly with followers in order to induce them to expand high efforts. This paper reports an experiment testing the efficiency of two costly communication devices introduced by Hermalin (1998): leading-by-example and leading-by-sacrifice. In leading-by-example, the leader's effort is observable by the follower. Experimental evidence shows that leadership works more through reciprocity than through signaling. In leading-by-sacrifice, the leader can give up a part of her payoff. Experimental evidence indicates that this sacrifice works as a truthful signaling device when it is lost for the follower but not when it is transferred to him.

JEL classification: C9, D82, M54
Keywords: Leadership, Signaling, Communication, Reciprocity, Experiments, Teamwork.

Le Leadership dans les équipes : effet de signal ou de réciprocité ?

Résumé

Comment fonctionne le *leadership* au sein des équipes? Le *leadership* s'appuie à la fois sur la possession d'une information privée par un *leader* et sur sa capacité à transmettre cette information de manière crédible aux autres membres de l'équipe de façon à les amener à exercer un effort important. Cet article présente une expérience visant à tester l'efficacité de deux modes de communication coûteux tels qu'introduits par Hermalin (1998). Avec le « *leadership* par l'exemple », seul l'effort du *leader* est observable par l'autre membre de l'équipe. Les résultats montrent que ce *leadership* fonctionne davantage par la réciprocité que par l'effet de signal. Avec le "*leadership* par le sacrifice", le *leader* peut renoncer à une partie de son gain, ce qui constitue une information sur l'état de la nature. Ce sacrifice fonctionne comme un mode de communication crédible lorsqu'il n'augmente pas le gain de l'autre membre de l'équipe mais pas quand il l'accroît directement.

Mots-clés: leadership, signal, communication, réciprocité, économie expérimentale.

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1. Introduction

High performing organizations tend to be more horizontal than hierarchical because self-managed teams may be highly adaptive to change, innovative and efficient. In particular, work monitoring and effort are not only a matter of hierarchy but also a matter of peer pressure. Because they contribute all together to the production of an outcome to be shared among them, team members can monitor their teammates sometimes more efficiently than a traditional hierarchy. However, this does not mean that no hierarchy exists in self-managed teams. Informal leadership can be frequently observed. Some employees exert an influence on others without being necessarily endowed with any kind of hierarchical authority. This supports the distinction between real and formal authority (Aghion and Tirole, 1997). Where does this power of influence come from and why do team members follow such an informal leader?

Political scientists have analyzed leadership in emphasizing the leader's ability to solve social dilemmas and coordination games, serving as a focal point (Calvert, 1992, Wilson and Rhodes, 1997). Economists have pointed out the role of leadership in improving the efficiency of hierarchies compared to markets in helping to reach a better equilibrium (Miller, 1992). However, despite the interest of economists for coordination, leadership has not attracted much attention in economic literature and even less interest has been shown on empirical evidence. Literature on the voluntary contribution to the funding of a public good has nevertheless revealed the influence on the followers' contribution of announcing previous leading contributions. In particular, a fund-raiser may increase the level of donations in announcing publicly the amount of past greatest contributions or seed money (List and Lucking-Reiley, 2002). Although controversial (Varian, 1994), this influence of leading announcements on the average contributions can be explained because they help agents to reach a guarantee that the public good will be provided (Andreoni, 1998), they favor warm-glow and snob-appeal (Romano and Yildirim, 2001), they enable the donors to demonstrate their wealth (Glazer and Konrad, 1996), or because they reveal an information on the quality of the public good (Potters, Sefton and Vesterlund, 2001). In another approach, Foss (1999) analyzes leadership as a method for transforming almost common knowledge into common knowledge, for selecting among multiple equilibria, or for reaching a higher equilibrium, less costly and lengthy than convention formation. However, the mechanism by which the leader may influence the follower's beliefs and behavior remains largely unexplored.

In the context of teamwork in organizations, Hermalin (1998) has provided a contribution in the theory of leadership, emphasizing the role of signaling for the efficiency of the leader's influence on the other team members. Such a capacity of an informal leader to influence the effort of the other team members derives from her ability to collect some information unavailable to the other team members. But this is not a sufficient condition. Leadership is grounded on both the possession of a private information by the leader and by her ability to communicate truthfully with followers in order to induce them to adopt some behavior. This ability to transmit information credibly within team is a key feature of the efficiency of interactions and can contribute to explain the preference for horizontal teams over hierarchical ones.

This paper aims at providing an experimental test of a simplified version of Hermalin (1998)'s model, with a team consisting of two agents: a leader and a follower. In this model, both have to realize an outcome the amount of which depends on their individual level of effort and on a random productivity parameter that determines the return of effort devoted to the common activity. This outcome is to be equally shared among the agents, thereby entailing a classical free-riding incentive (Holmström, 1982). Before choosing her level of effort, the leader is privately endowed with an unbiased information about the return of effort and she could try to transmit this information to the follower. Even though cheap talk can help in achieving a better coordination (Farell, 1987), in this context it cannot be a credible communication device. Because the leader shares in the team's output, she has an incentive to exaggerate the return of effort in order to induce the follower to expand high effort. Credible communication must therefore be costly to the leader. Following Hermalin (1998), we concentrate our experimental study on two costly devices, leading-by-example and leading-by-sacrifice. Thus, at the difference of studies which focus on the diversity of the leaders' types (Wilson and Rhodes, 1997), we consider the diversity of signaling devices.

In "leading-by-example", the leader is allowed to choose her effort publicly before the other agent chooses his own. When the leader is working hard, the follower can infer that a high return of effort prevails, whereas whenever the leader shows little effort, he should believe that a low return is likely. By such a commitment, the leader is able to convincingly transmit her information to the follower. In "leading-by-sacrifice", without such a publicly prior choice of effort, in order to convince the follower that effort pays big benefits, the leader has to commit to a side payment contingent on her private information. The more the leader sacrifices, the more likely is a high return of effort.

It must however be stressed that such a model of leadership relies entirely on the assumption that the follower grounds his decisions on the first mover's actions because he knows she is better informed. But it remains to be shown whether this signaling hypothesis is really what explains the observed leader's influence. Do people mimic the leader because they know that she is better informed or because they want to reciprocate her actions? In leading-by-example, the leader may induce the effort of the follower not only because the leader's effort signals her information, but also because the follower wants to reciprocate the leader's effort. Similarly, in leading-by-sacrifice, the influence of the leader on the follower's effort may be explained by both the signaling hypothesis and by the follower's desire to thank the leader for a high transfer or to punish her for a low transfer. In an experiment on the role of announcement of leadership contributions to a public good, Potters, Sefton and Versterlund (2001) have however shown that reciprocity cannot be the driving force explaining the leader's influence. But can this result be extended to team organizations ?

In order to assess whether signaling or reciprocity may account for leadership in teams, we have conducted various experimental treatments.

In leading-by-example, if both agents are informed of the productivity parameter, a first mover's influence cannot be attributed to a signaling effect. Therefore, so as to test the predictive power of the signaling hypothesis and to calibrate the reciprocity effect, we compare behavior in two different treatments of leading-by-example. In the asymmetric information treatment, only the leader is informed about the value of the return of effort whereas in the symmetric information treatment, both agents are informed about that value.

In leading-by-sacrifice, under asymmetric information and with a sole signaling effect, it is clear that there should be no difference in behavior whatever the sacrifice be transferred to the follower or lost for the follower. We therefore ran two different treatments of leading-by-sacrifice under asymmetric information: a treatment in which the sacrifice is transferred to the follower and a treatment in which the sacrifice is lost for the follower. If behavior differs between the two treatments, this could provide evidence for reciprocity concerns.

Experimental evidence shows that, when the leader's effort is observable, the follower "follows" the leader. Therefore, what one observes does depend on the leader's strategy. In the symmetric leading-by-example treatment, the leader actively tries and succeeds in inducing coordination on the highest level of effort. In the asymmetric treatment, by just playing her free riding effort, the leader mostly induces coordination on free riding issues. Thus, leadership-by-example works more through reciprocity than through signaling.

In leading-by-sacrifice, when a sacrifice is transferred to the follower, the leader uses it to reward the follower for his preceding choice of effort and to prompt him to continue such an effort independently of the state of nature. In contrast, the leader uses her sacrifice as a signaling device when it is lost for the follower. In both treatments, the follower is influenced by the sacrifice which is interpreted as a pure signal of the state of nature when lost for the follower, whereas the follower's reciprocity cannot be rejected when the sacrifice directly increases his payoff.

These results indicate first that the leader uses her signaling power only when there is no ambiguity on the meaning of the message. This is the case in leading-by-sacrifice when the sacrifice is lost for the follower. Second, they also indicate that leadership may work through reciprocity either when there is no need to signal the state of nature (symmetric leading-by-example treatment) or when the leader can directly influence the follower's payoff (leading by sacrifice being transferred to the follower). Third, when ambiguity is too high, the leader may even give up her leadership power as in the asymmetric leadership-by-example.

The remainder of this paper is organized as follows. Section 2 presents the basic frame of the leadership game, the layout of the two types of treatment (Example and Sacrifice treatments) and the theoretical predictions. Section 3 introduces the experimental design. Section 4 discusses the experimental data and comments on the econometric results. The final section summarizes the results and provides concluding remarks.

2. THE LEADERSHIP GAME

Let us first consider the basic frame of the game before introducing the two costly

communication devices.

2.1The basic frame of the game

The game involves a partnership consisting of two players who have to share equally an outcome that depends on their individual decisions of effort and on a random common productivity parameter θ. One of these two players is named Leader because she is endowed with a private information on the value of this parameter. Like a manager, the leader has to build an informational link between the environment and the organization (Mintzberg 1973). But unlike a manager, she has to participate in the realization of the outcome. The other player is named Follower and has no private information on the value of the parameter; he is only informed on the distribution function of the productivity parameter.

With e_i the player's effort level, $i \in \{L, F\}$, L for "leader" and F for "follower", the outcome y is defined as

$$y = \theta(e_L + e_F) \tag{1}$$

The random productivity parameter θ can take two possible values, either low or high, $\theta \in \{\theta_l, \theta_h\}$ and the probability for each possible value is 0.5.

The agents' payoffs are determined by subtracting an individual cost of effort from their share. The convex cost function, independent of θ, is the same for both agents so that for agent i :

$$C(e_i) = \frac{e_i^2}{a}, \text{ with } a > 0 \tag{2}$$

and an agent i's payoff function is thus given by :

$$U_i = \frac{1}{2}\theta(e_i + e_j) - \frac{1}{2}e_i^2 \tag{3}$$

In such a basic frame, the dominant strategies vary according to the available information.

(i) Since a high value of θ increases the marginal benefit of effort without increasing its marginal cost, an agent who is perfectly informed of the θ value has a strictly dominant strategy (a free riding strategy) that consists of choosing an effort increasing in the value of θ: $e_i = \frac{\theta}{2}$.

(ii) When uninformed of the θ value, with θ values drawn by Nature from a commonly known equiprobable distribution, the strictly dominant strategy becomes $e_i = \frac{\bar{\theta}}{2}$ with $\bar{\theta} = \frac{1}{2}\theta_l + \frac{1}{2}\theta_h$.

(iii) Under asymmetric information, communication may help agents to coordinate their efforts. However, cheap talk cannot lead to a credible communication device. With a signaling strategy considered as being credible by the follower, the follower's effort is increasing in the θ value announcement. And because the leader's payoff is increasing in the follower's effort, she has an incentive to lie, reporting high values of θ when the low value has been drawn. In this case, the only perfect Bayesian equilibrium is a babbling one in which the follower disregards the messages by playing $e_i = \frac{\bar{\theta}}{2}$ according to his 50-50 prior belief regardless of the received message. As cheap talk cannot be efficient, costly communication devices are requested for the message to be considered as credible.

Two costly communication devices are considered below in order to identify their ability to enforce coordination within the team[1].

2.2 Leading-by-example

In leading-by-example, the leader is allowed to choose her effort publicly before the other agent chooses his own effort. Under asymmetric information and according to the signaling hypothesis, the leader has to exhibit a level of effort that credibly signals $\theta = \theta_h$. Therefore, to be credible, this level of effort e_L^* must be such that the leader has no interest to choose it in the bad state.

In the bad state, $e_L = \frac{\theta_l}{2}$ clearly truthfully reveals the state of nature so that with such an effort in the bad state, the follower mimics the leader[2] and the leader's payoff is

$$U_{L(l,l)} = \frac{\theta_l}{2}\left(\frac{\theta_l}{2} + \frac{\theta_l}{2}\right) - \frac{1}{2}\left(\frac{\theta_l}{2}\right)^2 = \frac{3}{2}\left(\frac{\theta_l}{2}\right)^2 . \tag{4}$$

In such a state also, with an effort e_L inducing the follower to believe in $\theta = \theta_h$, the leader's payoff is

$$U_{L(l,h)} = \frac{\theta_l}{2}\left(e_L + \frac{\theta_h}{2}\right) - \frac{1}{2}e_L^2 \tag{5}$$

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[1] It should be noted that this model focuses on the separate efficiency of these two communication devices which are exogenously imposed to the leader, who cannot choose among them. This perspective differs from the study of links between leadership styles and the properties of contractual incentive schemes (Rotemberg and Saloner, 1993). It also differs from Güth, Müller and Spiegel (2002) which study the strategic behavior of leaders and followers through an "all-or-nothing" noise structure where followers either perfectly observe the leader's action or else observe nothing.

[2] This perspective differs from the theory of "yes men" (Prendergast, 1993) in which the informed party may be tempted to mimic the uninformed one.

Therefore, as far as e_L is such that $U_{L(l,h)} > U_{L(l,l)}$, the leader has an incentive to lie through her choice of effort.

With the following parameters $a = 2$, $\theta_l = 8$ and $\theta_h = 12$ chosen in the experimental "Example-Treatment" (see Appendix A), $U_{L(l,l)} = 24$. For the message $\theta = \theta_h$ to be credible, the leader has to commit to an effort at least equal to $e_L^* = 8$.

Because in the good state, the leader's payoff is greater by sending a credible information $\left(U_L(e_L^*, \frac{\theta_h}{2}) = 52\right)$ rather than by lying $\left(U_L(\frac{\theta_h}{2}, \frac{\theta_l}{2}) = 42\right)$, there exists a separating perfect Bayesian equilibrium such that in leading-by-example:

when $\theta = \theta_l$: $e_L = \frac{\theta_l}{2} = 4$ and $e_F = \frac{\theta_l}{2} = 4$

and when $\theta = \theta_h$: $e_L = e_L^* = 8$ and $e_F = \frac{\theta_h}{2} = 6$.

Thus, under asymmetric information, in order to convince the follower that the good state prevails, the leader has to work harder than under symmetric information (where without any reciprocity considerations both agents play $\frac{\theta_h}{2} = 6$). Therefore, in the good state, leading-by-example allows both an outcome greater than the one obtained under symmetric information and a higher total payoff (52 + 66 = 118 under asymmetric information and 54 + 54 = 108 under symmetric information). However, as a price of her truthfulness, the leader receives ex post a lower share of the outcome than her teammate.

2.3 Leading-by-sacrifice

In leading-by-sacrifice, without a public choice of effort, the leader has to commit to a side payment contingent on her private information. This side payment, "the sacrifice", consists of a monetary transfer $\delta(\theta)$ which will be subtracted from the leader's payoff. To credibly signal to the follower that $\theta = \theta_h$, the amount of the side payment must be such that the leader has no interest to commit to it in the bad state (the return from a lie must be lower than the cost of the signal for the leader).

When the bad state prevails, with a side payment δ considered by the follower as truthfully revealing $\theta = \theta_h$, the leader's payoff is

$$U_L(\frac{\theta_l}{2},\frac{\theta_h}{2})-\delta=\frac{1}{2}\theta_l(\frac{\theta_l}{2}+\frac{\theta_h}{2})-\frac{1}{2}\left(\frac{\theta_l}{2}\right)^2-\delta \qquad (6)$$

Therefore, to credibly signal $\theta=\theta_h$ to the follower, the side payment δ^* must be such that

$$U_L(\frac{\theta_l}{2},\frac{\theta_h}{2})-\delta\le U_{L(l,l)}=\frac{3}{2}\left(\frac{\theta_l}{2}\right)^2 \qquad (7)$$

With the following parameters $a=2$, $\theta_l=8$ and $\theta_h=16$ chosen in the experimental "Sacrifice-Treatment" (see Appendix B), $U_{L(l,l)}=24$. To be credible, the signal $\theta=\theta_h$ consists of a sacrifice at least equal to 16. In the experiment, because the leader can only choose between three values for the sacrifice {0, 10, 20}, she has to choose a sacrifice equal to 20 if she wants to credibly signal a good state of nature.

In the good state, the net payoff to the leader who has credibly sacrificed must be equal to or higher than her payoff obtained without sacrifice when the follower believes the state is bad. Because in the good state, the leader's payoff is greater by sending a credible information $\left(U_L(\frac{\theta_h}{2},\frac{\theta_h}{2})-20=96-20=76\right)$ rather than by lying $\left(U_L(\frac{\theta_h}{2},\frac{\theta_l}{2})=64\right)$, there exists in leading-by-sacrifice a separating perfect Bayesian equilibrium such that:

when $\theta=\theta_l$: $\delta=0$, $e_L=\frac{\theta_l}{2}=4$ and $e_F=\frac{\theta_l}{2}=4$

and when $\theta=\theta_h$: $\delta=16$, $e_L=\frac{\theta_h}{2}=8$ and $e_F=\frac{\theta_h}{2}=8$

It should be noted that without any reciprocity concerns and according to the signaling hypothesis, this solution is the same whether the sacrifice is transferred to the follower or lost for him. In both cases, the signaling problem is the same.

3. Experimental design

Basically we run two different types of treatments, Example-treatments and Sacrifice-treatments. In both types, a session consists of 25 periods where the leadership game is repeatedly played with the costly communication device associated with the treatment.

Because we want not only to test the leadership signaling hypothesis but also to calibrate reciprocity effects, Example-treatments are conducted either under asymmetric (Example-Asym) or symmetric (Example-Sym) information. For the same reason, Sacrifice-treatments (always conducted under asymmetric information) are run either with a sacrifice transferred to the follower (Sacrifice-Gift) or a sacrifice lost for the follower (Sacrifice-Lost).

We therefore get the following treatment Table:

Table 1. Treatment Table

Treatment	*Parameters*	*Information*	*Number of sessions*	*Location*	*Number of participants*
Example-Asym	$a=2$, $\theta_l=8$, $\theta_h=12$, $e\in\{4,6,8\}$	Asymmetric information Leading-by-example	2	Ecully	28
Example-Sym	$a=2$, $\theta_l=8$, $\theta_h=12$, $e\in\{4,6,8\}$	Symmetric information Leading-by-example	1	Ecully	16
Sacrifice-Gift	$a=2$, $\theta_l=8$, $\theta_h=16$, $e\in\{4,6,8\}$	Asymmetric information Sacrifice {0,10,20} given to the follower	1	Ecully	12
Sacrifice-Lost	$a=2$, $\theta_l=8$, $\theta_h=16$, $e\in\{4,6,8\}$	Asymmetric information Sacrifice {0,10,20} lost for the follower	2	Montreal	24

The experiment consists of four sessions with 12 participants each and two sessions with 16 participants each.

Two sessions correspond to the Example Treatment under asymmetric information and one under symmetric information. Two other sessions correspond to the Sacrifice Treatment with the sacrifice lost for the follower, and one additional session is run to test our control treatment with a sacrifice given to the follower.

All sessions, except those corresponding to the Sacrifice-Lost treatment, were conducted at GATE, University Lumière Lyon II, Ecully (France). The 56 subjects of these sessions were recruited from undergraduate courses in business at the Management School of Lyon, and from courses in engineering at the Institute of Textile and at Ecole Centrale de Lyon. The two sessions corresponding to the Sacrifice-Lost treatment were conducted at CIRANO, University of Montreal, Canada. The 24 subjects of these sessions were recruited at three Universities (Montreal University, Concordia University and University of Quebec in Montreal). All of the subjects were inexperienced in this kind of experiment. No subject participated in more than one session. On average, a session lasted 75 minutes including initial training and payment.

The experiment is computerized using in both countries the REGATE program developed at GATE. At the beginning of a session, subjects are assigned to a computer terminal by their random choice of a number in an envelope before entering the lab. Subjects are given a copy of the instructions, including the matrix payoffs, and the experimenter reads them aloud (see Appendix B1 and B2). A quiz on how to calculate the payoffs is to be completed by the participants, in such a manner that all cells of the payoff matrices are examined. Then, all questions by the participants are given an answer publicly. Afterwards, the subjects are separated by the computer network into groups of two.

In order to facilitate the emergence of an actual leadership in teams, role assignment and the composition of the team remain constant throughout the session. Thus a partner matching protocol is in use in all treatments. It is common knowledge that each subject is paired with the same subject throughout the session and interactions among the subjects are anonymous. Participants discover on their computer screen which role they are assigned after the instructions are read aloud and all questions given an answer.

All transactions are conducted in points. The final payoff is equal to the sum of the points earned in each period. At the end of the session, in France the total amount of points is converted into Euros at the rate 100 points = 0,9 € in the Example-treatments and at the rate 100 points = 0,6 € in the Sacrifice-Gift treatment. This difference in conversion rates is motivated by the willingness to guarantee similar average payments whatever the treatment played despite the use of different payoff matrices. In Canada, in the Sacrifice-Lost treatment, points are converted into Canadian Dollars at the rate of 100 points = 0,85 Can. $. A show-up fee of 2,5 € or 5 Can. $ is added. In both countries, earnings are paid privately in a separate room in order to preserve confidentiality.

Each session is divided into 25 periods. The number of sessions is common knowledge. At each period, decisions proceed as follows. In the Example Treatment-ASYM sessions, in stage 1, after having been informed on the computer screen of the value of the productivity parameter (“the multiplying coefficient”), the leader (“subject X”) chooses his effort, by clicking on the appropriate box on the computer screen. In stage 2, knowing the distribution function of the productivity parameter, the follower (“subject Y”) is informed of the leader’s effort and decides on his own level of effort. Once both members of a group made their decision for the period, the computer displays to both subjects the actual value of the productivity parameter, X and Y’ number choices and their earnings. In the Example Treatment-SYM sessions, the only difference is that both subjects are informed of the value of the productivity parameter at the beginning of the period.

In the Sacrifice-treatment sessions, in stage 1, after having been informed by the computer of the value of the productivity parameter, the leader chooses both his effort and the amount of the sacrifice. In stage 2, the follower is informed of the amount of the sacrifice and he chooses his effort. Then, the computer displays to both subjects the value of the productivity parameter, X and Y’ number choices and their earnings. The only difference between the Sacrifice-Lost and the Sacrifice-Gift treatments is that the sacrifice is lost for the follower in the first case and transferred to him in the second.

In addition, in all treatments, a historic table is kept visible on the computer screen, indicating for each period the summary information displayed at the end of each period. At the end of the session, participants are requested to answer a post-experimental questionnaire, in order to gather their interpretation of the game and a description of the strategies played by him(her)self and the participant (s)he was paired with throughout the session.

4. EXPERIMENTAL RESULTS

Let us consider first leading-by-example and then leading-by-sacrifice.

4.1. Leading-by-example

Table 2 displays the subjects' effort choices according to the value of the random common productivity parameter θ.

Table 2. Summary statistics on effort decisions in the Example-treatments

Symmetric Treatment	$\theta = 8$				$\theta = 12$			
Follower's effort	4	6	8	Sum	4	6	8	Sum
Leader's effort								
4	*23*	0	1	24	11	4	0	15
6	19	12	1	32	1	*17*	0	18
8	6	2	**31**	39	1	3	**68**	72
Sum	48	14	33	95	13	24	68	105
Asymmetric Treatment								
Follower's effort	4	6	8	Sum	4	6	8	Sum
Leader's effort								
4	***46***	27	10	83	11	7	0	18
6	24	34	2	60	29	**66**	8	103
8	12	5	14	31	14	*14*	27	55
Sum	86	66	26	174	54	87	35	176

Note: Bold numbers correspond to the most frequently played issues. The grey cells represent the free riding issues. The numbers in italics indicate the theoretical predictions.

Let us call the issue in which both subjects choose the highest effort a "cooperation issue" and the issue in which both subjects play their strictly dominant strategy a "free riding issue".

In the symmetric treatment in which both subjects have the same information about θ, unlike the theoretical prediction, cooperation is the most frequent issue observed. For the low θ value, there are 32.63% of cooperation issues and only 24.21% of free riding issues. For the high θ value, there are 64.76% of cooperation issues and only 16.20% of free riding issue. To appreciate the first mover's influence, we can also count the issues where the follower strictly mimics the leader (plays exactly what has been played by the leader). This leads to 64.47% of mimicry issues for the low θ value, and 91.43% of such issues for the high θ value. With symmetric information, it seems therefore clear that players coordinate themselves with some success on mutually advantageous issues and that this coordination process is much more successful for the high value of θ.

In the asymmetric treatment where the leader possesses a private information about θ, free riding is the most frequent issue observed whatever the value of θ. The frequency of cooperation is rather weak. For the low θ value, there are only 8.04% of cooperation issues and 26.43% of free riding issues. For the high θ value, there are only 15.34% of coordination issues and 37.50% of free riding issues. To appreciate the first mover's influence in this asymmetric treatment, we can also count the issues where the follower strictly mimics the leader. This leads to 54.02% of mimicry issues for the low θ value, and 59.09% of such issues for the high θ value, both percentages being lower than those calculated in the symmetric treatment. Thus, cooperation within the team is disturbed by the informational asymmetry between the two partners. But behavior also differs in the good state of nature from the theoretical prediction. Subjects coordinate themselves most frequently on the free riding issues and not on mutually advantageous issues.

In order to explain the differences between the two treatments, we have to look more closely at the leader's behavior and influence.

Clearly, without any informational asymmetry, such an influence cannot be related to a signaling effect concerning the unknown state of nature. In such a case, a usual hypothesis advanced to explain the success of coordination is to relate such a success to the subjects' use of some reciprocation strategies. The follower may want to reciprocate the leader's choice of an effort greater than the free riding level and knowing that, the leader may induce cooperation through such a choice. We test this reciprocation hypothesis in the symmetric treatment.

With informational asymmetry, things are less simple. A leader and a follower as well may take into account either a signaling effect or a reciprocation motivation, or both. It could therefore be interesting to investigate whether the failure of cooperation in the asymmetric treatment could be explained either by a lack of signaling or (and) by a lack of reciprocity. This hypothesis is tested in the asymmetric treatment.

4.1.1. *The reciprocation hypothesis in the symmetric treatment*

Testing the reciprocation hypothesis requires to test two hypotheses separately. The first hypothesis is whether the follower's choice of an effort greater than his free riding effort does depend on the leader's choice of such an effort. The second one is whether the leader's choice of effort takes into account the follower's decision at the preceding period. Because successive period decisions are not independent, both hypotheses are tested through a panel data analysis. Probit regressions with random effects are run since groups have been constituted randomly from a sample of heterogeneous individuals.

To test the first hypothesis, we use the three following dummy variables.

Folplus =1 if the follower chooses an effort greater than his free riding effort and = 0 otherwise,

Leadplus =1 if the leader chooses an effort greater than her free riding effort and =0 otherwise,

θ =1 if the high productivity parameter has been drawn by Nature, and = 0 if the low parameter has been drawn.

and we run a Probit regression to estimate the effect of *Leadplus* on *Folplus* according to the following equation:

$$prob(Folplus) = f(z)$$

with z being a latent variable defined as follows:

$$z_{it} = \beta_1 + \beta_2 Leadplus + \beta_3 \theta + (v_i + \varepsilon_{it})$$

where i denotes the group number and t the period number, and with an error term consisting of v_i, a time-invariant group-specific component, and ε_{it}, a remainder component assumed to be uncorrelated over time. Because of an obvious end game effect (the relative frequency of *Folplus* is zero at period 25), observations at period 25 are dropped out.

The results displayed in Table 3 show that the probability that the follower chooses an effort greater than his free riding effort is an increasing function of *Leadplus* and θ. This behavior is not influenced by any significant time trend.

Table 3. Determinants of a follower's effort greater than his free riding strategy in the symmetric treatment

P(Folplus=1)	Coefficient	P>|z|
Leadplus	3.24180	0.000
θ	0.92520	0.004
Constant	-2.66799	0.000
N	192	
Nb of groups	8	
Log likelihood	-55.98124	
Wald χ^2	40.99	
p> χ^2	0.000	

For $\theta = 8$, the mean predicted follower's probability to choose an effort greater than his free riding effort is 0.004 when the leader's effort is equal to or lower than her free riding effort and is 0.717 when the leader's effort is above her free-riding strategy. When $\theta = 12$, these probabilities are respectively 0.04 and 0.933.

To test the second hypothesis, we introduce one more dummy variable :

follow_1 =1 if at the former period the follower's effort was at least equal to the leader's one and = 0 otherwise

and we run a Probit regression to estimate the effect of *follow_1* on *Leadplus* according to the following equation

$$prob(Leadplus) = f(z)$$

with *z* being a latent variable defined as follows:

$$z_{it} = \beta_1 + \beta_2 follow\_1 + \beta_3 period + \beta_4 \theta + (v_i + \varepsilon_{it})$$

and with v_i a time-invariant group specific component and ε_{it} assumed to be uncorrelated over time. Also because of an end game effect (the relative frequency of *Leadplus* is 0.875 at period 24 and 0.375 at period 25), we drop observations at period 25.

Table 4. Determinants of a leader's effort greater than her free riding strategy in the symmetric treatment

P(Leadplus=1)	Coefficient	P>|z|
follow_1	0.92493	0.001
θ	-0.54310	0.044

period	0.04835	0.031
N	184	
Nb of groups	8	
Log likelihood	-72.40670	
Wald χ^2	20.45	
p> χ^2	0.000	

Table 4 shows that the probability that the leader chooses an effort greater than her free riding level depends on the fact that the follower "followed" her at the preceding period. For $\theta = 8$, the mean predicted leader's probability to choose such an effort is 0.699 when the follower did not follow her and 0.935 when he did follow her. For $\theta = 12$, these probabilities are respectively 0.507 and 0.841.

Last period excepted, the leader's cooperative behavior develops over time as shown by the positive sign associated with the period variable. It could be explained by a learning effect: even though the leader is immediately endowed with a formal leadership, the emergence of real leadership takes some time.

Finally, both regressions support the reciprocation hypothesis. The follower wants to reciprocate the leader's choice of an effort greater than the free riding level and, knowing that, the leader induces and keeps up cooperation through such a choice till the last round.

4.1.2. *Signaling and reciprocity in the asymmetric treatment*

We want to investigate whether the failure of cooperation and the distance to the theoretical prediction in the asymmetric treatment, as shown by Table 2, can be explained either by a lack of signaling or /and a lack of reciprocity.

Let us look first at the leader's strategy. In the asymmetric treatment, if we run the same Probit regression that was previously run for the leader in the symmetric treatment, nothing except θ is significant for the determination of *prob(Leadplus)*. The fact that *follow_1* is not significant suggests that the leader does not bother about the follower's behavior at the preceding period. But the striking fact is that we get a negative coefficient for θ (- 0.63287) although it would be in the leader's interest to choose a level of effort greater than her free riding level when θ is high if she wants to transmit a credible information.

To confirm the idea that the leader is not willing to use the opportunity to signal, one may tentatively adopt here the idea that, from the leader's point of view, any effort at least equal to 6 could be considered as a credible information when $\theta = 12$, thus introducing the dummy variable *signlarge* = 1 if the leader chooses an effort at least equal to 6 when $\theta = 12$, and = 0 otherwise. Now, a leader that consciously sends a signal should worry about the success of this strategy. Therefore, the probability to send such a signal at a given period should depend on the success of such sending at the preceding period. But, surprisingly, a Probit regression with random effects shows that this probability negatively depends on the fact that receiving the signal, the follower chose an effort at least equal to the leader's one. The probability to send such a signal is equal to 0.378 when the signal was successful and equal to 0.5 when unsuccessful.

If the leader does not use a signaling process, what does she do ? Because we know that she also does not worry about the follower's behavior at the preceding period, it seems that the leader mostly plays her free riding strategy associated with the known value of θ. In such a case, if the follower "follows" the leader, this can explain why cooperation within the team has been disturbed by the informational asymmetry between the two subjects. The follower followed a leader that did not try either to induce cooperation through her first mover's choice or to credibly signal the true state of nature. Subjects thus coordinate themselves most frequently on the free riding issues and not on mutually advantageous issues.

We can finally get some corroboration of this hypothesis by looking at the follower's behavior in order to know whether he "follows" the leader. We consider the two following dummies:

Fol6+ =1 if the follower chooses a level of effort greater than his lowest effort, = 0 otherwise,

Lead6+ = 1 if the leader chooses a level of effort greater than her lowest effort, =0 otherwise,

Table 5. Determinants of a follower's choice of a non minimum effort
in the asymmetric treatment

P(Fol6+=1)	Coefficient	P>|z|
Lead6+	0.60155	0.000
period	0.00871	0.385
Constant	- 0.21603	0.335

N	350
Nb of groups	14
Log likelihood	- 212.17021
Wald χ^2	14.96
p> χ^2	0.0006

The results displayed in Table 5 show that the follower follows the leader in that sense. Dropping the non significant variables, one gets a probability of 0.71 that the follower chooses a level of effort greater than his lowest effort when the leader does alike.

Thus, in the asymmetric treatment, the follower is influenced by a leader who gives up her leadership power and simply plays her free-riding strategy without any signaling or reciprocity concern.

4.2. Leading-by-sacrifice

In the Sacrifice treatments, the follower receives information neither on the productivity parameter θ nor on the current leader's effort, but only on the amount of the sacrifice.

Table 6 displays the subjects' effort choices according to the value of θ and the amount of the sacrifice, either transferred from the leader to the follower or lost.

It reveals that the overall use of the sacrifice is weak. In the good state of nature, it is weaker when the sacrifice is transferred to the follower (22%) than when it is lost (38%) although theory predicts no difference across treatments. In most cases, its amount is lower than what credibility requires (its amounts reaches 20 in only 7,1% of the sacrifices). It should be also noted that, in contrast with theory, one can observe sacrifices even in the bad state of nature. In the Gift treatment, 40.7% of the sacrifices occur in the bad state and only 19.7% in the Lost treatment. This difference in frequencies suggests that a transfer to the follower may be partly motivated by the leader's reciprocity concerns. Reciprocity concerns from the follower can also be inferred from the higher frequency of the follower's maximum effort when he receives a transfer (66.7%) than when the sacrifice is lost (53.5%).

Table 6. Summary statistics on effort decisions in the Sacrifice treatments

SACRIFICE-GIFT TREATMENT	$\theta=8$				$\theta=16$			
Sacrifice=0								
Follower's effort	4	6	8	Sum	4	6	8	Sum

Leader's effort								
4	*6*	**15**	13	34	3	1	1	5
6	9	8	10	27	2	2	2	6
8	1	1	2	4	17	10	***20***	47
Sum	16	24	25	65	22	13	23	58
Sacrifice >0								
Follower's effort	4	6	8	Sum	4	6	8	Sum
Leader's effort								
4	*1*	1	**5**	7	1	4	3	8
6			2	2			2	2
8			2	2	2		***4***	6
Sum	1	1	9	11	3	4	9	16

SACRIFICE-LOST TREATMENT	$\theta = 8$				$\theta = 16$			
Sacifice=0								
Follower's effort	4	6	8	Sum	4	6	8	Sum
Leader's effort								
4	*26*	11	19	56	5	-	3	8
6	7	3	4	14	5	3	9	17
8	7	7	**52**	66	12	7	***49***	68
Sum	40	21	75	136	22	10	61	93
Sacrifice >0								
Follower's effort	4	6	8	Sum	4	6	8	Sum
Leader's effort								
4	*3*	1	**6**	10	2	2	3	7
6	-		3	3	3	1	3	7
8	-	1		1	6	14	***23***	43
Sum	3	2	9	14	11	17	29	57

Note: Bold numbers correspond to the most frequently played issues. The grey cells represent the free riding issues. The numbers in italics indicate the theoretical predictions.

4.2.1 Reciprocity versus signaling in the leader's motivation

To test the hypothesis that the leader uses sacrifice as a signal of the true value of θ, we run a Probit regression with random effects using the dummy *sacrifice* (=1 if there is a positive side payment and 0 otherwise) and the variable *Fol_1* denoting the level of effort chosen by the follower at the preceding period. Results are displayed in Table 7.

Table 7. Determinants of the leader's sacrifice

	Sacrifice-Gift treatment		Sacrifice-Lost treatment	
p(sacrifice=1)	Coefficient	P>|z|	Coefficient	P>|z|
θ	0.37136	0.227	1.27727	0.000

Fol_1	0.31894	0.080	-0.06057	0.616
period	-0.04369	0.049	-0.04426	0.003
constant	-1.72632	0.002	-1.08462	0.034
N	144		288	
Nb of groups	6		12	
Log likelihood	-51.42083		-113.44692	
Wald χ^2	7.56		40.28	
p> χ^2	0.056		0.0000	

These results put to the fore the different motivations of the leader depending on the status of the sacrifice. In the Gift treatment, the coefficient of *Fol*_1 is significant and positive, whereas θ is not significant. Thus, the leader rewards the follower for his choice of effort in the preceding period to prompt them to continue such an effort independently of the value of θ. Such a leadership by reciprocating (and not by signaling) nevertheless declines over time.

In contrast, in the Lost treatment, the coefficient of θ is significant and positive whereas *Fol_1* is not significant. Thus, in this case, sacrificing is only motivated by signaling and the leader exerts her leadership by signaling and not by reciprocating.

4.2.2. The impact of sacrifice on the follower's behavior

To test the hypothesis that the follower interprets the sacrifice as a signal of the high value of θ, a Probit regression (with random effects) is run in which the explained variable is the probability of *Fol8* (=1 if the follower's effort is 8 and =0 otherwise). The variable *Lead_1* denotes the leader's effort at the preceding period. Results are displayed in Table 8.

Table 8: Follower's reactions to a sacrifice

	Sacrifice-Gift treatment		Sacrifice-Lost treatment	
p (Fol8 = 1)	Coefficient	P>|z|	Coefficient	P>|z|
sacrifice	1.15667	0.006	0.42355	0.049
Lead_1	-0.03795	0.788	0.12784	0.184
period	0.03010	0.083	0.03714	0.003
constant	-0.83760	0.068	-0.61209	0.073

N	144	288
Nb of groups	6	12
Log likelihood	-80.88309	-165.51922
Wald χ^2	9.86	12.43
p> χ^2	0.019	0.006

As shown by Table 8, in both treatments, the sacrifice variable is significant and its coefficient is positive whereas *Lead_1* is never significant. In the Gift treatment, the follower does not reciprocate to the leader's effort in the preceding period but he may reciprocate to the leader's sacrifice in the current period. As a consequence, sacrifice cannot be purely interpreted as a signal on the state of nature. In contrast, in the Lost treatment, sacrifice can only be interpreted as a signal and it does influence the follower's behavior.

Thus, if one considers the overall treatments, it is only when there is no ambiguity on the meaning of the sacrifice that leadership works by signaling: both the leader invests in communication to signal the state of nature and the follower interprets the sacrifice as a signal on this state.

5. Conclusion

Informal authority may be efficient if a leader, endowed with a private information, is able to communicate truthfully with followers in order to induce them to adopt some behavior. This paper dealt with two questions: Where does this power of influence come from and why do team members would follow such an informal leader?

An experimental analysis of a simplified version of Hermalin (1998)'s model of leadership, distinguishing leadership-by-example and leadership-by-sacrifice in a two-agent partnership, has been carried out. It tests the importance of signaling for the efficiency of the leader's influence on the other team member. Four main treatments were conducted in varying both the quantity and quality of information displayed to the follower and the leader's signals. These various treatments are motivated by the willingness to disentangle two possible motivations supporting leadership: signaling and reciprocity.

In leading-by-example, when the leader's effort is observable, the experimental evidence shows that the follower "follows" the leader. Therefore, what one observes does depend on the leader's strategy. In the symmetric leading-by-example treatment, the leader actively tries and succeeds in inducing coordination on the highest level of effort and leadership works through reciprocity. In the asymmetric treatment, by just playing her free riding effort without neither a truthful signaling strategy not a reciprocating strategy, the leader mostly induces coordination on free riding issues and gives up her leadership power.

In leading-by-sacrifice, the leader exerts her leadership power by reciprocating (rewarding the follower for his preceding choice of effort and prompting him to continue) and not by signaling when her sacrifice is transferred to the follower. In contrast, leadership by signaling is demonstrated when the sacrifice is lost for the follower. In any case the follower follows his leader but the sacrifice is purely interpreted as a signal only in the second case.

These results indicate first that the leader uses her signaling power only when there is no ambiguity on the meaning of the message. This is the case in leading-by-sacrifice when the sacrifice is lost for the follower. Second, they indicate that leadership may also work through reciprocity either when there is no need to signal (symmetric leading-by-example treatment) or when she can directly influence the follower’s payoff (when the sacrifice is transferred to the follower). Third, when ambiguity is too high, the leader may even give up any leadership power as in the asymmetric leadership-by-example.

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Appendix A. Matrix of net payoffs

θ=8 (for both Example Treatments and Sacrifice Treatments)

Leader's payoff

		F: 4	F: 6	F: 8
L	4	24	32	40
L	6	22	30	38
L	8	16	24	32

Follower's payoff

		F: 4	F: 6	F: 8
L	4	24	22	16
L	6	32	30	24
L	8	40	38	32

θ=12 (for the Example Treatments only)

Leader's payoff

		F: 4	F: 6	F: 8
L	4	40	52	64
L	6	42	54	66
L	8	40	52	64

Follower's payoff

		F: 4	F: 6	F: 8
L	4	40	42	40
L	6	52	54	52
L	8	64	66	64

θ=16 (for the Sacrifice Treatments only)

Leader's payoff

		F: 4	F: 6	F: 8
L	4	56	72	88
L	6	62	78	94
L	8	64	80	96

Follower's payoff

		F: 4	F: 6	F: 8
L	4	56	62	64
L	6	72	78	80
L	8	88	94	96

Appendix B1. Instructions for the Example Treatment – Asym

You are participating in an economics experiment which is supported by the CNRS. During this experimental session, you can earn money. The amount of your earnings depends not only on your decisions, but also on the decisions of the other participants.

This session consists of 25 periods. During each period, you earn points. Your final payoff is equal to the sum of your points earned in each of the 25 periods. At the end of the session, the total amount of points you have earned is converted to French Francs at the following rate :

10 points = 0.6 FF

In addition, you receive a show-up fee of 15 FF. Your entire earnings from the experiment will be immediately paid to you in cash in a separate room in order to preserve the confidentiality of your payoff.

Throughout the session, the group of participants is subdivided into two categories of roles: X participants and Y participants. At the beginning of the session, you will discover on your computer screen which of these two roles you have been assigned at random. You keep **the same role** throughout this session.

At the beginning of the session, all participants are randomly matched in teams of two participants (one X participant is matched with one Y participant). You interact **with the same person** throughout this session. Interactions are anonymous. You will never be informed of the identity of this person.

Throughout the entire session, talking is not allowed. Any violation of this rule will result in being excluded from the session and not receiving payment. If you have any questions regarding these instructions, please raise your hand. Your question will be answered publicly.

Decisions stages in each period

- In each of the 25 periods, X participant and Y participant are to compose a pie, which will be shared among them. The size of the pie is determined as follows.

  - Once each of the two participants, X and Y, has chosen a number among 3 possible numbers (4, 6 or 8), these two numbers are added up.

  - This amount is then multiplied by a coefficient. A chance move determines one of two possible values for this multiplying coefficient: either 8, or 12. The probability for 8 is 50%, the probability for 12 is 50%.

  Let's consider an example: X participant has chosen the number 6 and Y participant the number 8; the chance move has determined a multiplying coefficient of 12. Therefore, the pie to be shared sums to: 12 (6+8) =168. In contrast, with a multiplying coefficient of 8, the pie would have been 8 (6+8) = 112.

- The resulting pie is shared equally within the team between X participant and Y participant.

In the above example, with a multiplying coefficient of 12, each participant receives: 168/2=84.

- A cost is deducted from the individual shares of the pie, depending on the number chosen by the participant, as given by the Table below. This allows to determine the net payoffs of each participant.

Chosen Number	4	6	8
Cost	8	18	32

In the example above, the net payoff for X participant amounts to 84 – 18 = 66 and the net payoff for Y participant amounts to 84 – 32 = 52.

For the two possible values of the multiplying coefficient, and depending on the numbers chosen by the two participants, the payoffs net of costs are given for each participant in the two Tables distributed apart.

Each period is organized as follows.

Within the team, only X participant, who is the first mover, is informed of the value of the multiplying coefficient, before taking his decision.

In contrast, Y participant is not informed of the value of the multiplying coefficient when he takes his own decision. He is only informed of the X participant's decision before taking his own decision.

- **First stage**: X participant is informed of the value of the multiplying coefficient determined by the chance move. Then, he chooses a number among three (4, 6 or 8) to constitute the pie. Y participant will be informed of this choice but not of the coefficient before choosing his own number.

- **Second stage**: Y participant is not informed of the value of the multiplying coefficient but he is informed about the number chosen by X participant. He chooses to his turn a number among three (4, 6 or 8).

At the end of the period, a summary table indicates to X and Y participants: the numbers chosen by X and Y which contribute to determine the pie to be shared, the amount of the pie to be shared, the value of the multiplying coefficient determined by the chance move, and the net payoffs of X and Y.

At the end of a period, once all participants have taken their decision, a new period starts automatically. The new period has the same characteristics, you keep the same role, you interact with the same person. A new chance move determines the new value of the multiplying coefficient.

Thank you for your participation.

* * *

Appendix B2: Instructions for the Sacrifice Treatment – GIFT

You are participating in an economics experiment which is supported by the CNRS. During this experimental session, you can earn money. The amount of your earnings depends not only on your decisions, but also on the decisions of the other participants.

This session consists of 25 periods. During each period, you earn points. Your final payoff is equal to the sum of your points earned in each of the 25 periods. At the end of the session, the total amount of points you have earned is converted to French Francs at the following rate :

10 points = 0.4 FF

In addition, you receive a show-up fee of 15 FF. Your entire earnings from the experiment will be immediately paid to you in cash in a separate room in order to preserve the confidentiality of your payoff.

Throughout the session, the group of participants is subdivided into two categories of roles: X participants and Y participants. At the beginning of the session, you will discover on your computer screen which of these two roles you have been assigned at random. You keep **the same role** throughout this session.

At the beginning of the session, all participants are randomly matched in teams of two participants (one X participant is matched with one Y participant). You interact **with the same person** throughout this session. Interactions are anonymous. You will never be informed of the identity of this person.

Throughout the entire session, talking is not allowed. Any violation of this rule will result in being excluded from the session and not receiving payment. If you have any

questions regarding these instructions, please raise your hand. Your question will be answered publicly.

Decisions stages in each period

- In each period, X participant and Y participant are to compose a pie, which will be shared among them. The size of the pie is determined as follows.

  - Once each of the two participants, X and Y, has chosen a number among 3 possible numbers (4, 6 or 8), these two numbers are added up.

  - This amount is then multiplied by a coefficient. A chance move determines one of two possible values for this multiplying coefficient: either 8, or 16. The probability for 8 is 50%, the probability for 16 is 50%.

  Let's consider an example: X participant has chosen the number 6 and Y participant the number 8; the chance move has determined a multiplying coefficient of 16. Therefore, the pie to be shared sums to: 16 (6+8) = 224. In contrast, with a multiplying coefficient of 8, the pie would have been 8 (6+8) = 112.

- The resulting pie is shared equally within the team between X participant and Y participant.

In the above example, with a multiplying coefficient of 16, each participant receives: 224/2=112.

- A cost is deducted from the individual shares of the pie, depending on the number chosen by the participant, as given by the Table below. This allows to determine the net payoffs of each participant.

Chosen Number	4	6	8
Cost	8	18	32

In the example above, the net payoff for X participant amounts to 112 – 18 = 94 and the net payoff for Y participant amounts to 112 – 32 = 80.

For the two possible values of the multiplying coefficient, and depending on the numbers chosen by the two participants, the payoffs net of costs are given for each participant in the two Tables distributed apart.

Each period is organized as follows.

Within the team, only X participant, who is the first mover, is informed of the value of the multiplying coefficient, before taking his decision.

In contrast, Y participant is not informed of the value of the multiplying coefficient when he takes his own decision. He only receives an information from the X participant before taking his own decision.

- **First stage**: X participant is informed of the value of the multiplying coefficient determined by the chance move. Then, he has to make two choices:

  - The choice of a number among three (4, 6 or 8) to constitute the pie. Y participant is not informed of this choice.

  - The choice of the transfer of a proportion of his current period payoff to Y participant. This transfer constitutes the only information given to Y before he takes his own decision regarding the choice of a number in order to constitute the pie. This transfer is to be chosen among three (0,10 or 20).

- **Second stage**: Y participant is not informed of the value of the multiplying coefficient. He is not informed of the number chosen by X participant. He is only informed about the amount transferred by X participant.
  He chooses to his turn a number among three (4, 6 or 8) to constitute the pie.

At the end of the period, a summary table indicates to X and Y participants: the numbers chosen by X and Y which contribute to determine the pie to be shared, the amount of the pie to be shared, the amount of the transfer from X to Y, the value of the multiplying coefficient determined by the chance move, and the net payoffs of X and Y.

- The final payoff of X participant is obtained by subtracting from his net payoff the amount of the transfer to Y participant.
- The final payoff of Y participant is obtained by adding to his net payoff the amount of the transfer from X participant.

At the end of a period, once all participants have taken their decision, a new period starts automatically. The new period has the same characteristics, you keep the same role, you interact with the same person. A new chance move determines the new value of the multiplying coefficient.

Thank you for your participation.

* * *

Net payoffs of X and Y participants

The **blue shaded numbers** are the payoffs of **participant X**

The **yellow shaded numbers** are the payoffs of **participant Y**

If coefficient 8 has been drawn

Number chosen by X	Number chosen by Y:	4	6	8
	4	24 24	32 22	40 16
	6	22 32	30 30	38 24
	8	16 40	24 38	32 32

If coefficient 12 has been drawn

Number chosen by X	Number chosen by Y:	4	6	8
	4	40 40	52 42	64 40
	6	42 52	54 54	66 52
	8	40 64	52 66	64 64